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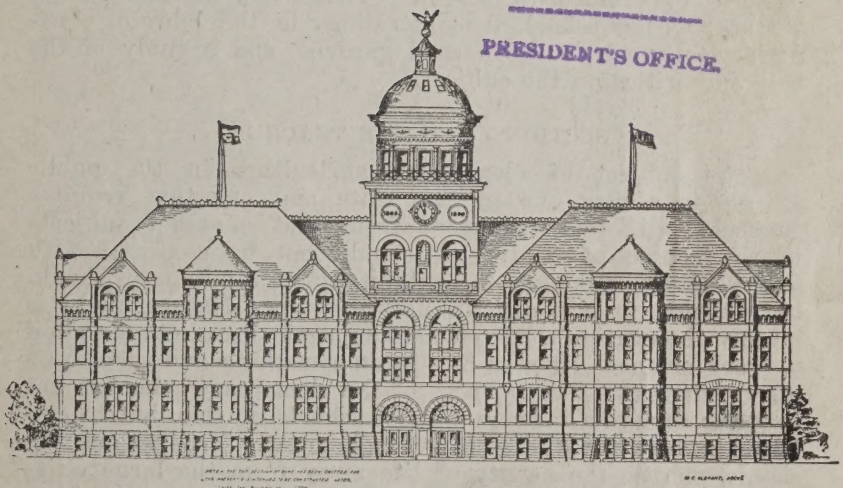

(THE DOME IS TO BE ADDED LATER)

THE SPRING TERM BEGINS MONDAY, MARCH 30, 1908

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Agriculture in the Elementary Schools

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This outline is prepared for both teacher and pupil. The first section has to do with the method of teaching the subject and hence is of interest to the teacher alone. The second section deals with the subjects that should be taken up in grades one to six inclusive. Facts are stated that can be used by either the teacher or pupil. The third section deals with subjects that should be taken up in the seventh and eighth grades and in the high school. It is not conclusive, but rather suggestive. Much of the outline is based on the writer's experience in teaching elementary agriculture in a state normal school, demonstrations in the labratory, experimental work in the normal gardens, and a study of the best authorities on the subject.

SECTION I.—TO THE TEACHER.

The subject of elementary agriculture in the public schools is a new one in this state and one that requires somewhat different treatment from that of other subjects in the course of study. It should not be confused with nature study, although it contains many topics that should be included in a course in nature study. Nature study is largely observation work, elementary agriculture sets the pupil to work at once. It asks him **to do** something and then draw his conclusions. The purpose of the elementary school is not to make scientific farmers, special schools do this, but to cultivate a love for the country and country occupations. It should picture the beauty of life away from the large cities and show that there are as great opportunities upon the farm as there are in the city. The boy and girl in the city should also be interested in country life and occupation. They should be taught the dependence of all classes upon the success of agricultural pursuits. If the productions of the soil should fail for one year, starvation would result.

To have a permanent place in the course of study a subject should furnish mental discipline and culture. It should train the powers of the mind in their logical order. Agriculture does this. The first work in the school is of the nature of observation. Memory, imagination, judgment, and reason are appealed to as the child advances from grade to grade.

As to the culture feature, nature is the mother of culture. The teacher does not need to have much of the poetic spirit to draw lessons of culture from a trip to the farm or a few hours spent in the school garden. Unless the teacher can see clearly that the study of elementary agriculture fulfills the above conditions, his teaching is sadly defective. The course of study in most of the states does not take into consideration the first real requisite of elementary agriculture. The lessons of today, this week, and this year should bear a definite relation to those of tomorrow, next week, and next year. Culture is not the sole aim, mental discipline must have a share.

The success of a course in this subject will depend largely upon the teacher's personal enthusiasm in the collection and arrangement of material. This does not mean that the teacher must be a specialist in order to teach the subject; it does mean that she must look upon the work as a part of the regular school course, plus an opportunity to come into closer contact with her pupils.

Problems of arithmetic and rules of grammar are easy to find when needed for class work, but samples of various grains, grasses, weeds, and soils are not easy to obtain at all times. Therefore it is necessary to obtain these in their seasons. Those that can be collected after the opening of school in September should be collected by the children under the teacher's direction. Bundles of wheat, oats, barley, flax, stalks of corn, and bunches of the different grasses should be collected and fastened to the picture moulding in the school room. Children should be encouraged to bring as many different kinds as they can obtain in the neighborhood. Besides serving the purpose they are intended to serve they also add beauty to the school room. The best school work is obtained under the most pleasant circumstances. If the workshop is pleasant, the work done will be of a high grade. Continual association with the things of nature make them a part of ourselves. Window gardens, potted plants, an aquarium and pictures of rural life will assist in many ways. Insects may be studied very carefully by watching them for several days when under glass cover in the school room.

As far as possible the thing should be studied in its season. The teacher should plan the year's work as soon as she has determined what the materials at hand are. Animals can be studied at one season as well as another. The winter months are the ones when it is hardest to find material—hence animal study should be taken up then. After a careful consideration on the part of the teacher it will be found that every part of the subject has its particular season.

The method of dealing with a particular subject must be such that the child can apply what he learns to the actual thing in later life. It must be looked at as a whole and then

as to its parts. For example, the child can more easily grasp the stem of wheat than he can some of the historical facts connected with wheat. The facts already clearly in mind can be made the basis of new facts. Build up fact after fact until the whole subject stands as a unit in the child's mind. This can be done if an interest is maintained throughout the work. Drawings and written descriptions are valuable. The extent to which the work can be correlated with other subjects is a disputed question. Few teachers are successful along these lines. The teacher of mathematics in this school finds it profitable to assign problems in agriculture to his classes in arithmetic. He believes that arithmetic can be more successfully taught if the pupil is dealing with a problem that has an answer which is worth obtaining. Truly the management of a school garden will offer ample opportunity for lessons along this line. A composition that describes something worth describing is the one written about agricultural pursuits. Map drawing, in which the township, county, and even one farm is drawn, but which indicates the industries, is profitable work for the class in geography.

Excursions are the most difficult part of the course. They are also the most valuable. An excursion, to be successful, must be well planned before it is undertaken. The teacher must be sure that she will find what she is going to see. The children should be informed what they are expected to see and do. It is best to asign certain topics to certain pupils and also encourage them to observe any other things of interest. After some time has elapsed, collect the children and ascertain what each one has done. The same order should prevail that would in the school room. Additional facts should be called for. Suppose, for instance, that you are to visit Mr. A's stock farm to study his horses. The teacher should ascertain the leading facts concerning Mr. A's horses and assign topics to bring out these facts. Review in school what was learned on the excursion.

The last suggestion that the writer will offer is, use every means to connect the school with the home. Interest the parents in your work. The instruction in agriculture may not be confined to the child, it may instruct the parents.

SECTION II.—THE FIRST SIX GRADES.

In agriculture as in other branches of school work the child, in the first years of his school life, can be expected to do but little real work. This period may well be called the observation period. Learning the names of common plants and animals with some study of their most marked characteristics is all that can be expected.

First Year.

(a) **Plants.** Collect as many different shaped leaves as possible and classify them as to shape, size, color, and margins. Call attention to the parts of a leaf. Study six common trees, noting their names and external characteristics. Study the different kinds of fruit grown in the neighborhood. Why the fruit is gathered in the fall and the care that is given it in the winter. Call attention to the house plants, and the care that is given them. Watch the first changes that come to the trees in the spring. What do the farmers do in the spring? Name the different grains that are planted in the spring.

(b) **Animals.** Get from the children the names of all the animals that are raised in the neighborhood. Select the ways in which they are alike and unlike. Study the horse and cow as to their habits, uses, and external appearance. Name the common birds and study them in the same way that the horse and cow were studied. Note that some kinds of birds leave us in the fall. Why? Note the time when they go. Watch for their return in the spring. Study their nesting habits, care of young and the number of their young. Learn the names of a few common insects and how they live.

(c) **Weather.** A large weather calendar should be made by the teacher, the children furnishing the data. This should be large enough to be seen in every part of the school room. An ordinary large calendar can be used. Cloudy days can be colored with one color, storms with another, and on the clear days the numbers can remain white. The four directions, north, south, east, and west, should be taught early in the year. Place a weather vane on the school building. Before the year is over the children will associate the state of the weather with the direction of the wind.

Second Year.

The work of the first year should be reviewed and enlarged upon. A year's time will add much to a child's knowledge at this period. His vocabulary has increased and he is able to write simple words and sentences. Oral and written descriptions should play a more prominent part in the work.

(a) **Plants.** In the first year the child learns to identify some of the common trees by means of their more marked characteristics. Add to these as a further means of identification, the bud system, branches, and bark. Consider some of the less common trees. The uses of trees. Learn the names of the different parts of a plant. Note the resemblances in plants. Identify some of the common weeds about the school house. Make a more thorough study of the work on the farm in the spring months. About two weeks before the opening

of spring plant, in pots, several different kinds of grains and study them as they come through the ground, and as they later add leaves and develop a stem.

(b) **Animals.** Make a study of the hen, as to breed, color, size, marked characteristics, uses, and care. Encourage the children to observe the hen for some time. Compare the hen with the animals studied the first year. This will give an opportunity to enlarge upon the work of the first year. New facts can be developed. Study the sparrow as a winter bird. Point out that it is our most injurious bird and the ways in which it is injurious. Associate the return of the birds in the spring with the work of the farmer. Develop the fact that birds are the farmer's friends.

(c) **Weather.** Note the changes that take place all about us with the coming of fall. The ways that we prepare for winter. Observe the length of days. Make a record of the thermometer readings. Study the action of frost. Make an excursion to a farm to study the care of animals in winter. Kindness to animals can be easily introduced after the excursion. Continue the weather calendar, indicating in addition to the points noted in the first year, the direction of the wind, rain or snow fall and the thermometer readings.

(d) **Observation Lessons.** Simple exercises that will illustrate natural phenomena should be conducted by the teacher. This will require careful observation by the children and will assist them in doing similar work later. The conversation method will bring out the facts to be remembered.

Third Year.

The work of the third year becomes more thorough and requires more effort on the part of the pupil. Composition work, drawing careful oral descriptions, and a strong emphasis upon comparisons should characterize the work of this year.

(a) **Plants.** Compare several farm plants as to their size, shape, leaves. fruit. roots, uses, and cultivation. Germinate several different kinds of seeds between blotting paper and note their growth. Teach the names of the parts of the seed and of the young plant. Plant seed under different conditions to illustrate the effect of heat, light, moisture, and depth of planting. Note the time that the farmer plants his different crops and the preparation given the seed bed. Children should be encouraged and required to visit a farm when the different crops are planted. Children in this year's work are sufficiently advanced to assist in the school garden.

(b) **Animals.** Make a careful study of the horse and cow. Note all external characteristics and traits. Care and uses to man are important topics. Compare the two. Study them as to the cost of keeping. Make a year's estimate and use data in arithmetic work. Study the grasshopper as a

typical insect. Note the parts of the body and the relation that they bear to the habits of the insect. Study its manner of life and the relation that it bears to agriculture. Call attention to some of the harmful and some of the beneficial insects and the ways in which they are harmful or beneficial.

(c) **Weather.** The farmer's interest in good weather in the fall months. Threshing of grain and marketing, fall plowing, late pasturing, and an opportunity to repair the farm buildings are topics that can be considered in connection with the weather. Work on the farm during the winter and early spring. Study further the changes that take place with the return of spring. Bad roads. repairing machinery, testing seed grains, and finally the planting.

Fourth Year.

The work of the previous years has been largely observation work. Facts were added by the teacher, but the child was required to do little real investigating. The teacher now becomes the guide and stimulus, the pupil the doer. Exercises are added which will require thought as well as observation.

(a) **Plants.** Make a careful study of the cereals. The study of the uses of the cereals can be made more interesting if the pupils can visit a flour mill and see how flour and feed are made. Interest will further be stimulated if a brief discussion of bread making follows. Study the life history of the flax plant from the seed to the time it is made into cloth or flax-seed meal. The coal regions of the state are interesting. How and when coal was formed. Its value to the state. Draw a map of the state indicating the topography, coal regions. kinds of farming, railroads, and a few of the large cities. Collect statistics from the farmers as to the cost of raising different grains. Compare these and try to account for the differences. In the spring study the common weeds and the methods of eradicating them. Finish the year's work on plants by making an outline which will include all the principal facts connected with the raising of cereals in your locality. The facts found in the last part of this bulletin will assist the pupil.

(b) **Animals.** Make a general study of all the animals useful to man, as the horse, cow, hog, mule, sheep, and hen. Make frequent excursions to farms where the best breeds are raised. Outlines should be provided for the children which will indicate the points to be observed. When possible measurements of animals should be made and the weight taken. Stock judging in an elementary way is not beyond children in the fourth year.

(c) **Machinery.** The names of all the pieces of machinery used on the farm and for what purpose they are used. Make an estimate of their value. How to care for machinery,

by housing, painting, repairing, and oiling. Compare the machinery used today with that used twenty years ago. What effect has the introduction of improved machinery had upon farming? How many acres will four horses and one man plow in one day? How many acres will they harrow? How many acres of wheat will they cut? How many bushels of wheat will they draw to the nearest market three miles away?

(d) **Soil.** Collect different kinds of soil and learn their names. Ascertain. if possible. the number of bushels of wheat that an acre of clay soil will produce. An acre of sandy soil and an acre of humus soil. It may be difficult for the pupils to ascertain all of these facts, but in the effort they will gather considerable valuable information. Indicate on the map already drawn, the character of the soil in different parts of the state. Consult Williard's "Story of the Prairies" as to the character of the soil in different parts of the state. What do we understand by "shallow soil"? Should it be plowed deep or shallow. Why? Why should the soil be fine before a crop is planted? Why do we cultivate corn and potatoes? Plant seeds in the different soils collected and note the growth of the plants. Show that air and drainage are necessary to a plant by puncturing several holes in the bottom of a fruit can. Fill the punctured can, and another can not punctured, with the same kind of soil. Plant four kernels of corn in each can. From time to time add the same amount of water to each can. Note the growth of the plants in each can.

(e) **Farm Problems.** How many quarts of milk per day does the average cow give? Compare the answers given by the different pupils. Does the breed, care, and age of the animal have any bearing upon the quantity of milk given? Make an estimate of the cost of keeping a cow a year and of the income to the owner. Estimate the cost of raising an animal for beef purposes. This should include the total cost until the animal reaches the stock yards in St. Paul. Estimate the cost of harvesting and marketing a quarter section of wheat. Suppose that the quarter section was divided up into small fields of grain, grasses and pasture, would it cost more or less to farm the land? Explain. Would this have any bearing upon the fertility of the soil? Explain. Why should the farmer be interested in good roads? How can roads be improved? What determines the kind of agriculture carried on in a community?

Fifth and Sixth Years.

The work of these two years is combined for the reason that pupils are nearly always able to do the same work in both years. If the teacher finds this imposible, the outline given

will permit of modification and selection that will be adapted to both years.

(a) **Plants.** The plants of the farm are grains, grasses, tubers, roots, legumes, fruit trees, vegetables, timber trees, medical plants, fiber plants, and stimulent plants. Study each as to (1) Identification of seed. (2) Where the plant is found. (3) The cultivation. (4) Uses to man and the processes by which it is made useful to man. (5) Its relation to the soil. (6) Its relation to climate. (7) Is it an annual, biennial, or perennial? (8) The approximate cost of production.

(b) **Conditions Necessary to Plant Growth.** A plant to do its best must have (1) Air, and the elements which it contains. (2) Water. (3) Soil which contains the proper chemical elements. (4) Cultivation. (5) Proper drainage. Make a careful study of the best methods of bringing about the above conditions.

Plant Foods. The plant obtains its food from the air, soil, and water. The leaves of plants are provided with very small openings, or pores, which serve as air passages. Through these openings the plant takes in carbonic acid gas and throws off oxygen. A small cell called a guard cell surrounds each breathing pore. These prevent the escape of an undue amount of moisture. Nitrogen does not enter the plant through the leaves, but is taken up by the roots. It is one of the most important plant foods and is necessary to all plant growth. The amount of nitrogen in the soil differs in different places. In a humid climate the largest amount is found in the surface from six to twelve inches. Land upon which several crops of wheat have been raised in succession, lacks a sufficient amount of nitrogen and we speak of the land as run down. Nitrogen can be brought into the soil through decaying organic matter, through rains, and by means of leguminous plants. Upon the roots of certain plants, called legumes, there are small organisms which bring the free nitrogen of the soil and air into contact with the roots of the plant. Every plant must have certain elements found in the soil. Potassium, calcium, magnesium, phosphorus, sulphur, iron, nitrogen, and chlorine exist in the soil in different proportions. Water acts as food itself, dissolves other foods, and carries them to the places where they are needed. To do this a large amount of water is necessary. The surplus is given off through the leaves. Wet grass in the morning is often due to the moisture given off by the grass rather than the fall of dew. The plant takes the material which it obtains from the soil and the air and makes them into starch, sugar, oil protein, cellulose, the elements of the plant.

When we burn a piece of wood in the stove the carbonic acid gas, oxygen, water and nitrogen pass off into the atmos-

phere, while the mineral matter remains as ashes. For exercises on plant foods see Bulletin 195, Office of Experiment Stations.

(c) **Plants and Animals Compared.** In the lower forms of life it is difficult to tell which is plant life and which is animal life. In the higher forms we have no difficulty in noting the following differences: The animal takes in oxygen and breathes out carbonic acid gas. The plant takes in carbonic acid gas and breathes out oxygen. The animal can move about while the plant is stationary. The animal lives upon organized material while the plant lives upon unorganized matter and makes it into organized material.

It is clear from our previous study that both plants and animals will live, reproduce and thrive better under certain conditions than under others. Indicate on the map the parts of the state which are the most suited to the best production of animal and plant life. State reasons why you select certain parts as better adapted to this than others.

(d) **The Home.** The work on the home is introduced thus early in the course for the purpose of stimulating an interest in beautiful surroundings. Teach that the essentials of a good home are, (1) its location to a market; (2) healthful surroundings; (3) a house well ventilated from cellar to garret; (4) scientific plumbing; (5) an abundance of sunlight; (6) good books, papers and magazines; (7) conveniences in the arrangement of rooms; (8) cleanliness; (9) modern conveniences, as bath-rooms, electric bells, and telephone; (10) an outside appearance in keeping with the inside.

(e) **Corn Contest.** Every boy in town, over thirteen years of age, should be induced to enter a corn growing contest. The State Agricultural College is always willing to supply the necessary seed corn. Give each boy enough corn to plant a plot 5 rods by 4 rods. The boy should do all the work of preparing the soil, planting, cultivating, and harvesting. Near the last of October have the different boys bring to school five of the best ears grown. A competent judge should be selected who will award the prizes. An essay neatly written describing the work done should accompany each boy's samples. The essays and samples of corn should become the property of the school. The following year the best ears of corn can be used for seed in the next contest. As in the previous year, other ears should be brought to school and used for corn judging contest. The outline on page 21 of Shepperd and McDowell's "Elements of Agriculture" will furnish the pupil an outline for judging corn.

(f) **Exercises.** 1. Moisten a piece of bread and rub over it a lemon that has mould upon its surface. Most decayed lemons are covered with a white material which is called mould. Cover the bread and place it in a warm room. Stick

a pin in a decayed apple and then stick the pin into a sound one. Watch for results. In both experiments what took place? Should decayed fruit or vegetables come in contact with those that are sound? Consult Farmer's Bulletin No. 153.

2. Plant five hills of potatoes in one part of the school ground and five hills in another. Select seed that is as nearly alike as possible. Give the ten hills the same care, except that the potato bugs are removed from the first five and are not from the second. In the fall weigh the potatoes received from the first five hills and compare this weight with those of the second five hills. What are your conclusions?

3. Plant five hills of corn near each other. Select for seed five different varieties of corn. When the corn is gathered in the fall, how many varieties have you? Explain the process of fertilization.

4. Plant four rows of corn, two rows in a place, in different parts of the home garden. Cultivate frequently the first two rows. One of these rows cultivate to the depth of six inches and very close to the hill. Give the second two rows but little care. Permit the weeds to grow. When the corn is gathered in the fall, weigh the corn from the first two rows and compare with the weight of the corn grown in the second two rows. Compare the weight of the corn grown in each of the first two rows.

5. Fill two flower pots with soil taken from the same place, but use the surface soil for one pot and the subsoil, or the soil that is found at a depth of a foot and a half below the surface, for the other pot. Plant in each pot a half dozen kernels of corn. Give each pot the same care. Note results. How can the surface soil be enriched?

6. Heat thoroughly over the fire a basin full of dirt. Be sure that all the vegetable matter is consumed. Place this soil in a tomato can which has holes in the bottom. Fill another can with soil taken from the same place, only the soil should not be heated. Plant in each can six kernels of the best wheat that can be obtained. Give to each can the same care and conditions. What do you conclude is one of the necessary elements of a productive soil?

7. Fill seven flower pots with poorest soil that can be obtained, either sand or clay. In the first pot mix thoroughly ten grams of lime plus one gram of phosphoric acid. In the third mix some very fine manure. In the fourth mix five grams of lime and two grams of sodium nitrate. In the sixth use nothing but the soil as gathered except in watering the plants that are grown in this pot use water that has perculated through manure. In the seventh pot the soil remains as it was collected. Plant three kernels of corn in each of the seven pots and give to each the same care. Tabulate results.

8. Fill a tin pail with rich, moist soil and weigh it. Place it in the sun or near a stove and weigh it every day for a week. Keep a record of the weights. What proportion of the soil is moisture?

9. Prune the trees on the school ground or obtain permission to prune some neglected trees on a farm near the school. See Farmer's Bulletin No. 181 and the directions given in this Bulletin.

10. Each child should be taught the process of grafting and budding.

11. Determine the number of kernels of wheat in a head —the same of oats and barley.

12. Write an essay which shall describe carefully the work done on the largest farm in your vicinity.

SECTION III.—THE GRAMMAR GRADES AND THE HIGH SCHOOL.

The many subjects covered makes is impossible to state only facts and to state them in as few words as possible. The teacher should not permit, nor the pupils be content, to learn simply the facts stated. The topics should be looked up thoroughly in some standard text on Agriculture. Explanations and additions will be necessary by the teacher. Demonstrations by the pupils cannot be over-estimated at this period. Each pupil should be required to keep a neat and complete note book in which additional facts are noted and the results of experiments recorded. Agricultural contests of all kinds should be encouraged.

Soil.

Nature of the Soil. Soil is that which covers the under strata of the earth. It is made up of particles of rock and decayed organic matter. The word soil usually refers to the first few inches of the earth's surface. The earth underneath is called subsoil. The latter is less productive than the former. The depth to which soil is fertile varies at different places, depending upon how it was made. Heat, cold, water, frost, animal and plant life have formed most of our soil. The expansion and contraction of a rock at different seasons will cause it to break up into fine particles. Fissures in rocks were filled with water, this froze and caused the rock to break apart. The wind carrying particles of soil tends to wear away rocks, running water carrying pebbles wears away larger rocks and pebbles, thus adding more soil. Vegetable life acts upon rocks by secreting an acid which destroys them. Roots penetrate into the crevices and force the rock apart. Animals burrowing into the soil let the air penetrate, which has a tendency to further pulverize the small rock particles.

Kinds of Soil. Soil that is largely composed of vegetable matter is called humus soil. This kind of soil is found mostly

in damp places. It is generally of a dark color and is very productive. It is easily worked and retains water. Sandy soils are those soils which contain a large amount of sand. They are called "light soils" because they are easily worked. In parts of Dakota where the rainfall is sufficient they are productive soils. They are formed by the weathering of sandstone. Clay soils are known as "heavy soils" for the same reason that sandy soils are known as "light". Clay is formed by the weathering of limestone. When it is wet the particles stick together. It is hard to cultivate and is not a productive soil. Heat does not enter it readily and it will remain cold for a long time. Soils contain various proportions of the above. The particular name that we give a soil is determined by the kind which predominates. The most productive soil is the one which contains a right proportion of the three.

How to Improve the Soil. (a) By tillage. The air is permitted to reach the under soil, thus breaking it up, drying up excessive moisture, and mixing the different kinds of soil. The soil on top which has become exhausted is turned under and allowed to rest, while that underneath is brought to the top. It raises the temperature and hastens plant growth. (b) By drainage. Wet soils are cold. Plants will not send their roots down into wet soil, and the air is unable to penetrate to the depth that it does when there is a deep root system. Warm rains are thus enabled to soak into the ground. (c) By fertilizers. Add to the soil barn-yard manure, commercial fertilizers, lime and ashes, plowing under the stubble, straw and weeds. (d) Rotation of crops. Do not plant one crop on the same piece of land for successive seasons. Follow a rotation something like the following: Clover, potatoes, wheat, hay. (e) By planting of legumes. Certain plants, such as beans, peas, alfalfa, and clover, add nitrogen to the soil by means of small tubercles on the roots. These tubercles are formed by minute organisms which take the nitrogen from the air and give it to the growing plants. (f) By fallowing or permitting it to lie idle.

How to Conserve Moisture. In many parts of this state it is very important that as much of the moisture should be retained as possible. The following methods are employed: (a) Fall plowing presents an uneven surface and when the rainfall and snow is slight there is no chance for the water to run off or the snow to blow into drifts. The frost disintegrates the soil and renders it more suitable for planting early in the spring. (b) Keeping a soil mulch on top. That is, there should be several inches of soil on top which is very fine. The moisture cannot pass up through it. Frequent cultivation, and especially after a rain, will form a mulch. (c) Varying the depth of cultivation according to the season. (d) Selecting of crops which are best adapted to the particular

kind of soil. Certain crops take nourishment from near the surface, while others go down deep. The object of conservation of moisture, in brief, is to get as much moisture into the soil as possible and to give it to the plant at the necessary time.

Practical Exercises on Soil. 1. Have each pupil make a collection of the different kinds of soils in the locality of the school. Teach the names, the characteristics and the composition. Next put like soils together in boxes for work in other exercises.

2. Fill several bottles with the various kinds of soil. Tie a piece of cloth over the end of each bottle. Bore holes in a piece of board for the neck of each bottle to pass through. Invert the bottles with their necks passing through the holes extending into tumblers, each containing the same amount of water. Note which takes up the most water and which the least. What do we call this process?

3. Tie cloths over the top of several lamp chimneys and fill the chimneys with different kinds of soil. Invert chimneys in a basin of water and see which soil will take up the most water. Let them stand in the room and see which dries out the most rapidly.

4. Plant seeds in the different soils and note the growth of the plants. Tabulate results from day to day.

5. Make a clay ball and let it freeze for two or three nights. Bring it into the school room. What happens? Does this have any bearing on fall plowing? Explain.

The Atmosphere.

Composition. The air is composed of the following gases: Nitrogen, 76.95%; Oxygen, 20.61%; Water vapor, 1.40%; Argon, 1.00%; Carbon dioxide, 0.03%. They exist free from each other and are located at different heights. Carbon dioxide is the heaviest and is found near the earth. Oxygen, nitrogen, and water vapor are all lighter and are found in the order named.

Uses. Oxygen. It is necessary to all life in that it supports combustion. Animals breathe it in and plants breathe it out. Nitrogen. It forms the pressure and density of the air. It is one of the necessary plant foods. Microscopic forms of life convert it into organic forms. Carbon dioxide. It is formed by plants and animals and is given off in the process of respiration. Decaying matter gives it off, also volcanoes, chimneys, mineral springs. It is the principal food of plants which take it into the cells, retain the carbon and give off the oxygen. Water Vapor. It varies in different places according to the temperature.

Relation of the Atmosphere to the Soil. Air is needed in the soil to supply the necessary oxygen. Air produces chemi-

cal changes in the preparation of plant food, and is necessary to germination. The amount of air in the soil is regulated by the kind of crops grown, the tillage, drainage, and the supply of vegetable matter. Water escapes through the soil by the process of evaporation. When the air becomes saturated it falls again in the form of rain. The agents which affect evaporation are heat, cold, the sun, wind, and the formation of a soil mulch.

Atmosphere and Climate. The condition of the atmosphere determines the climate at that particular time. To determine the climate of a place several successive years must be taken into consideration.. In the United States there are several belts of climate. Each belt has largely its own animal and plant life. The temperature is the great controlling factor. While animals are able to live under more adverse climatic conditions than plants, due to the power of regulating the temperature of the body, yet animals must have plants for food. Thus the two are confined to the same regions. Plants and animals thrive best when they are well adapted to their surroundings. For example, it is better to raise wheat that is a native of North Dakota than to bring in a variety from some other state.

Seeds.

Definition and Parts. A seed is a matured ovule. Its parts are: (a) Hilum, a little scar produced by the seed becoming detached from its covering. (b) The micropile, a little hole or opening at the end of the hilum. Water enters it in germination. (c) The coverings or skin, which are for protection. (d) The cotyledons, the inner parts or halves. In the bean they are the two parts which come through the ground first. When two are present the plant is said to be a dicotyledon, and when only one it is said to be a minocotyledon. (e) The flumule, a little bud of undeveloped leaves. (f) The radicle, that part which becomes the root and stem.

Selecting Seeds. The value of selecting good seed can scarcely be estimated. Seeds that have little vitality should not be planted. To get good seed a plot of the best soil should be put aside and the crop raised from it should be saved for the next year's seed. Fertilizers should be added from time to time and crop rotation practiced. If grain is being raised it should be thoroughly sifted and only the full, plump kernels planted. When possible, seed should be selected in the fall when the crop is being harvested. One should know the plant from which the seed came Seed that has been kept for over a year loses some of its vitality. Store seed in a dry place, after it has been thoroughly dried in the fall. Seed should be tested in the spring before it is sown. For example, select five kernels of corn from the tip end, five

from the middle, and five from the butt end. Place these in a germinator and watch them for several days. Mark the ear from which these kernels came. If several kernels do not germinate, the ear from which they came should be discarded. The depth to which seeds may be planted depends upon the size of the seed, climate, and the nature of the seed leaves. In sowing small seeds the ground should be in as fine a condition as possible to secure covering for as many seeds as possible.

Every pupil should make a collection of all the seeds grown in the neighborhood. These should be brought to school, and studied carefully as to their external appearance and germination.

Practical Exercises on Seeds. 1. Demonstrate that heat, air, and moisture are necessary to germination by planting seeds in three different jars when the above conditions are present and also in three jars when they are not present.

2. Select twenty large seeds and plant. Also twenty of the smallest seeds in the same collection. How many germinate in each case? Which germinate first? Note the growth of the two kinds. Conclusions?

3. Plant ten beans and when they are well through the ground, cut off the cotyledons of five. Keep all under the same condition. How does the growth compare? Conclusions as to the purpose of the cotyledons?

The Plant.

Importance of the Plant. In studying a plant we must think of it as doing a work not unlike that done by the human body. It is a living, growing thing. It unites the elements of the air and soil into an organic whole. All food may be traced back to the plant. It has two kinds of work to do—get nutrition and reproduce itself. Any means that man may invent to assist in these processes will increase the plant supply and directly benefit mankind. Water, heat, soil, and light are the agents which directly affect plant growth. Plants purify the air by taking up the carbonic acid gas and giving back to the atmosphere oxygen. They give beauty to the surface of the earth and add to the comfort of man.

The Parts of a Plant. The parts are, root, stem, leaf, flower, and fruit. (a) The root of a plant is that part which holds the plant in place and acts as the storehouse for food and serves to carry nourishment. Collect as many different kinds of roots as you can find. Notice the small root hairs. These are to collect nourishment for the plant. Name several roots that are used for food. (b) The stem is that part of the plant above the ground which suports the leaves, flowers, and fruit. It also carries the plant food from the root to the various parts of the plant. Some plants, as the quack

grass, have underground stems. Only the leaves are above ground. Such plants are the most hardy and often the most troublesome. Cultivation breaks the stems and produces a greater number of plants. The kinds of stems above ground are the erect, procumbent, floating, and climbing. Name several of these different kinds of stems. What are the advantages of each? Every stem has its own peculiar way of extending its leaves to the light. What kind of a stem has a shrub? Herb? The parts of a dicotyledonous stem from outside toward the center are the epidermis, cambium layer, cortex, and pith. The small holes on the surface are called lenticles and are used by the plant in breathing. (c) The leaf is an expanded portion of the branch. The purpose of leaves is to give off water, absorb carbonic acid gas and to make plant food, under the influence of sunlight by uniting the gas received from the air with the water taken from the earth. The color is due to the presence of a green substance called chlorophyll. Leaves are of various shapes and position on the stem. The object of their arrangement is to receive as much sunlight as possible. Rich, moist soil produces an abundance of leaves and few flowers. Name some of the ways in which leaves are useful to man. Burn some leaves in the stove. What do you observe? From what does the largest part of a leaf come? On the surface of leaves are a large number of little openings called stomata. They serve as lungs for the plant. (d) The flower is also a modified part of the branch. Its parts are calyx, corolla, stamens, and pistils. The flower exists for the purpose of reproducing the plant. The sole purpose of the beautiful colored flowers is to make this process more sure. Collect several different kinds of flowers and study the devices to aid insects in reaching their nectar. (e) The fruit is the result of the ripening of certain parts of the flower. Name all the uses of fruits. Name the different kinds of fruit.

Classification of Plants. Plants are classified in relation to agriculture as (a) Cereals. Examples are corn, wheat, rice, and barley. (b) Forage crops. Examples are the grasses, and legumes. (c) Fiber plants. Examples are cotton, flax, and hemp. (d) Fruit plants. Examples are apple, peach, and cherry. (e) Underground plants. Examples are potato, and all plants where roots are used for food. (f) Stimulant plants. Examples are tea, coffee, and tobacco. (g) Timber crops. Examples are the forests. Where are each of the above grown? Their economic value? Sketch their life histories.

The Relation of the Plant to its Environment. The following agencies affect the life of a plant: (a) Heat, air, and light. (b) Moisture. (c) Chemical composition of the soil. (d) Fertilizers. To grow a plant successfully one must know

that the above conditions are suited to the particular plant. One plant will require more of one element than another. All plants require the same food, but they differ in the amount.

Practical Exercises on Plant Ecology. 1. Plant several kernels of corn in a pan and place the pan in the sunlight. Plant several more kernels in another pan and keep it in a cool place from the sunlight. Record results. (a) Which germinated first? (b) Number of kernels in each pan that germinated? (c) Growth?

2. Select two house plants of the same class. Give to one an abundance of water and to the other a small amount from time to time. What do you observe? Later, transplant each plant. Place one in a pot which contains very rich earth and the other in poor soil, such as clay or sandy soil. Watch their growth.

Disease of Plants. It is a well known fact that animals are subject to many of the same diseases that affect man. One animal communicates disease to another and he in turn is likewise affected. The diseases which are common among plants act in the same way. To prevent plant disease is better than any remedy that can be applied after the disease has become manifest. These diseases reproduce themselves by means of small seeds called spores. They are very small and easily carried about by the wind. The most common plant diseases are:

(a) Smuts. These affect the heads of grain and unless the seed is treated before planting the disease is communicated to the young plant. Grains that have the least indication of smut should be thoroughly sprayed or dipped in a solution of formalin before planting. The loss each year due to this fungus parasitic disease is enormous.

(b) Potato Blight. Brown spots are often seen on the potato leaves. Later numerous spores are found on the underside of the leaf. These fall to the ground and finally reach the tuber itself and produce rot. The Bordeaux mixture sprayed over the plant before the spores mature will remedy this disease.

(c) Potato Scab. This is a fungous growth upon the potato itself. It gives the potato a rough appearance and damages it to no small extent. Soil which grew potatoes afflicted with this disease usually carries the disease over from year to year. Seed potatoes should be soaked in a solution of formalin for three hours. Dry the potatoes and plant on soil that does not contain the scab.

(d) Black Knot. This is a common disease of the cherry and plum tree. Large swellings of the twig appear, which later breaks through the bark and a spongy mass appears. Soon the mass looks like a large wart with deep fissures. It is one of the most destructive diseases and every caution

should be taken, when the disease first appears, that it be eradicated. The only remedy is to cut off the diseased part and apply paint to the stub of the branch. Burn all branches thus removed.

Rotation of Crops. Explanation. Rotation of crops is the regular order in which one crop follows another. When several different crops are planted year after year on the same ground, we speak of it as a series of rotations. The following rotation is a good one: Potatoes, barley, clover, wheat, corn. The potatoes require thorough cultivation and the weeds are not likely to seed. Barley takes a different proportion of plant food from the soil. It matures in a short time and has a fibrous root system, taking its food largely from the top of the ground. Clover brings the nitrogen of the air into the soil and supplies that which the barley used. Its roots are large and go to some depth. The stubble and the second growth, if it is allowed to partially mature before being plowed under, will add much more food to the soil. After this the soil is in excellent condition for wheat and corn.

The Importance of Rotation. (a) Soil that grows the same crop year after year becomes worn out. (b) Plants differ in the amount of food that each takes from the soil. For example, one plant needs more nitrogen than another. (c) Plants take nourishment from different depths, depending upon the root-system. (d) Different plants require different cultivation. This makes it possible to eradicate weeds and injurious insects. (a) Leguminous plants add nitrogen to the soil. (f) Different crops mature at different times. which gives a better distribution of labor than the planting of one kind of crops. (g) Rotation leaves the soil in a better mechanical condition.

Ask the pupils to draw a map of their home farm or a farm near the school building. Indicate the crops that have been grown on each field for the last three or five years. Have them ascertain the number of bushels grown per acre and on what principles the owner plants one crop on one field and another crop on another field.

Wheat.

History. Wheat has been grown from the earliest times. In fact the history of it goes back beyond records. Where it originated is not known. It is thought that it was first grown around the Mediterranean Sea. It has always been used as a food. It was brought to America by the early settlers and has attained a wide distribution.

Classification. Wheat is classified according to color as white and red; according to softness, as hard and soft; according to chaff, as bearded or free; according to the season when it is sown, as winter and spring; according to name, as durum

or macaroni and common wheat. The last one mentioned includes those kinds which are hard to classify. There are upward of 1000 known varieties of wheat. The Scotch Fife, Blue Stem, and Marcaroni varieties are best adapted to North Dakota. The Macaroni is making rapid strides and may become one of the leading varieties grown in the northwest.

Production. Wheat ranks third in value of the crops grown in the United States. The following states produce most: Minnesota, the Dakotas, Ohio, Kansas, Nebraska, California, Iowa, and Missouri. The total production for the year 1907 was 634,000,000 bushels. The following foreign countries lead in the production of wheat: Russia, Austria-Hungary, France, Argentine, and Germany. India, also, produces no small amount.

Climate and Cultivation. It is grown in a wide range of climate. This is made possible by the fact that in parts of the country where winter wheat cannot be grown, spring wheat takes its place. It adapts itself readily to different climates, which accounts for the large number of varieties grown. It is not advisable to bring varieties from states where the climate is very mild to a state where the range of temperature is so great as it is in North Dakota. However, it will gradually become acclimated. There is not enough snow fall in this state to raise winter wheat successfully.

The soil should be plowed in the fall to conserve mositure. In the spring it should be thoroughly harrowed to produce a soil mulch. Clay loam is the best kind of soil. The subsoil should be firm to retain the moisture which is needed later in the season. If the soil is too wet in the spring after it is planted and while the wheat is getting its growth, the roots will not go down sufficiently to reach the under moisture. From five to six pecks per acre should be sown. The seed should be selected with the utmost care—full, plump, bright kernels, free from weed seed and smut. Plant with a drill two inches deep. A bushel of wheat weighs sixty pounds.

The Plant Itself. When the young plant comes through the ground it has one stem and three roots. If the weather is cool and there is sufficient moisture it will stool or send out branches. These branches soon attain the same size as the first stem and thus several heads of wheat will be produced from one kernel. The stems are hollow which aids in rigidity. At the different nodes leaves are found. These are parallel veined, which would be one indication that the plant belonged to the grass family. The flower is inclosed within a chaff which prevents cross-fertilization. The roots are fibrous and go down to a depth of three feet. Wheat is very hard upon the soil, taking more nitrogen than most any other crop. It has been estimated that it requires 40 pounds of nitrogen, 15

pounds of phosphoric acid, and 25 pounds of potash to produce 25 bushels of wheat.

Diseases of Wheat. Rust and smut are the two common diseases. Rust is a parisite plant which eats into the stem, taking the nourishment which the plant needs in maturing the kernel. Consult a text book on Botany as to the life history of rust. There is no remedy for rust. Smut is also a fungous plant. It affects the berry directly rather than the stem. The remedy is to apply a solution of formaldehyde to the seed before planting. One pint of 40% formaldehyde to forty-five gallons of water should be sprayed over the seed and permitted to dry.

Question. Where do we find a market for most of the wheat grown in this state? Is it good farming to raise nothing but wheat upon a farm? Why? Why not? How does the number of bushels per acre grown today compare with the number grown ten years ago? Explain.

Is it good policy to burn straw? Explain. What do we mean by Minnesota grades? Which variety of wheat makes the best flour? Explain the process of bread making.

Testing Wheat. Take a quart of wheat from different parts of the bin and weigh it. Remove all dirt, weed seed, half kernels, and other foreign matter. Weigh again, and subtract from the total weight. What per cent of this wheat is pure?

Select one hundred grains from another quart of wheat. Take others as they are, not choosing the best. Place these between blotting paper in a room where the temperature is not lower than 80 degrees fahrenheit. Count the number of kernels that do not germinate. What conclusion do you reach?

Corn.

History. Corn was first found growing in America. Mexico is probably its native home. The early settlers to this country mention that it was growing in various parts of North America. The Indians knew its value and raised it extensively. Kernels are found buried with the mummies of Mexico.

Classification. There are six races of corn—dent, flint, pop, sugar, soft and pod corn. The ones that we are most interested in are the dent and flint races. These two get their names from the dent in the kernel and the hardness of the kernel. Some varieties of dent corn are: Golden dent, North Dakota No. 100, Pride of the North, Northwestern Dent, Minnesota King, and the various White Dents. Each state has its own varieties, i. e. various names are given varieties of corn that are closely related, depending upon the locality. Some varieties of flint corn are Triumph, Mercer, Longfellow, Will's Dakota, and Gehu. Other varieties are grown, but not so extensively. The flint varieties seem to be the best adapted

to North Dakota. They ripen earlier and seem to withstand the climate better than the dent varieties. The writer would recommend Triumph as the corn to be grown in school contests. Golden Dent and North Dakota No. 100 are also good.

Production. The United States produces about 2,500,000 bushels. The average yield per acre is 24 bushels. It also produces three-fourths of the world's crop. The following states produce the largest part: Illinois, Nebraska, Iowa, Kansas, Indiana, Ohio, and Missouri. The growing of corn in the Northwest is making rapid strides. The time is past when it was considered impossible to raise corn in this section of the country. Other countries raising corn are: Austria-Hungary, Mexico, and Russia.

Climate and Culitvation. Corn, as has been said, is of tropical origin. It requires a longer season than most of the other cereals. A warm season with plenty of moisture is necessary to a good yield. A cold summer will "set it back" and may prevent it ripening before the frost comes. No variety should be planted that is not reasonably sure of maturing twelve days before the ordinary time for frost. If the season is early, corn should be planted as soon as the top of the ground has dried and warmed. Wet soil prevents germination and produces an uneven crop. Fall plowing is best. In the spring the soil should be thoroughly stirred. This should be done at least twice before planting. Plant in hills 45 inches apart with three kernels in a hill. The number of kernels will depend upon the quality of the land and the vitality of the seed. The cultivation should be deep at first, becoming more shallow as the corn becomes larger. This will not cut off the roots, but will aerate the soil. Light soil will not take as deep cultivation as the heavy soils. A mulch should be kept the entire season. After a heavy rain the top of the soil should be loosened. In the Red River Valley ridging corn is not a bad practice. In the western part of the state where the rainfall is less it is necessary to conserve all the soil moisture and ridging should not be practiced.

The Plant Itself. Nature has wonderfully made the corn plant. Every part of its structure is admirably fitted to do its work. To look upon a quarter section of corn is to be impressed with the beauty and dignity of agriculture. The roots are of two kinds, prop roots and multiple primary or fibrous. These later go down to a depth of four feet. The stem is large at the bottom and tapering toward the top. It is made up of a series of nodes and internodes with fibro-vascular bundles and pith inside. The whole structure lends strength. The leaves are long, tapering and parallel veined. The first or main ear is formed about one-half way up the stalk. It is grown at the end of a stalk similar to the main stalk. The leaves of this secondary stalk form the outer husks. The

flowers are of two kinds—the tassel is the male flower or staminate, while the ear is the female flower or pistillate part. The pollen grains are scattered by the wind and fall upon the silks and fertilize the female flower. Each kernel must receive a pollen grain before it will mature. Cross-pollination takes place. Are there any advantages in this method? The kernel is rich in starch and is made up of five parts: The tip part, the embryo, hull, corneous part, and starchy part. There is always an even number of rows. Corn with deep kernels produces the largest yield. The length of the ear varies from six to twelve inches and the weight of the grain from eight to sixteen and one-half ounces. The variety, soil, and season will determine this. A bushel of shelled corn weighs fifty-six pounds. In the ear a bushel weighs seventy pounds.

Seed Corn. Select the variety that you feel is the best fitted for your locality. Be sure that the seed planted conforms to the characteristics of this variety. The time to select seed corn is in the fall before it is harvested. It is necessary to know the size of the stalk, number of ears on the stalk, and on what part of the stalk they grew. An ear of corn selected for seed should be well filled at butt and tip. It should be perfectly ripe, rows close together and the cob firm. It should be thoroughly dried and placed where no moisture can reach it. Before planting it should be tested as to its vitality. Two varieties should not be planted near each other, to prevent mixing.

Questions. Is the word corn used in the Bible? If so, what is meant? How does corn act in very dry weather and why? Name all the uses of corn. Is there any part of it that is wasted? Why does the United States lead in the production of corn? What part did corn play in the early settlement of this country? What is the price of corn per bushel? Can corn be fed at home to more profit than shipping it? Explain how. How many entered the corn growing contest last year? How many will enter it this coming spring? The United States Department of Agriculture will furnish pupils with valuable bulletins on corn.

Corn Description. The following outline is not a corn judging card but an outline to acquaint the pupil with an ear of corn. Each pupil should bring to school at least ten of the best ears of corn that he can obtain. Each ear should be studied according to the following outline:

I. **Names of Sample and Variety.**

II. **Is It True to Type?**

III. **Ear.**

(a) Shape.
(b) Length.
(c) Circumference.
(d) Weight.

IV. **Rows.**

(a) Number of rows.
(b) Space between rows.
(c) Space between kernels.

V. **Butt.**

(a) Size as compared with entire ear.
(b) How filled.

VI. **Tip.**

(a) How filled.

VII. **Kernel.**

(a) Length.
(b) Shape.
(c) Dent.
(d) Uniformity.
(e) Number of kernels absent.
(f) Total weight.

VIII. **Color.**

(a) Grain.
(b) Cob.

IX. **Cob.**

(a) Circumference.
(b) Rigidity.
(c) Weight.

X. An estimate of the ear as a whole.

Other Cereals. The other cereals, oats, rye, barley, and emmer should be taken up in the same method as wheat and corn. A thorough study of two cereals outlined will make the study of these last named an easy matter. The pupil should endeavor to answer every question concerning these that is answered concerning the first two. Consult reference works in agriculture.

The Grasses.

Importance. It is estimated that 43% of all the cultivated land of the United States is used for the production of hay or pasture. The raising of stock makes it necessary to

devote this large area to grass. It is probable that in the future more land will be devoted to this purpose. The production of hay and the feeding of it on the farm means an improvement in the soil. It is cheaper to raise an animal and market it than to raise the crop on which it is fed and market the crop. For example, it has been estimated by the New York Agricultural College that with every $10.00 worth of corn sold, $3.78 worth of fertilizer is sold, but with every $10.00 worth of cattle only $1.18 worth of fertilizer leaves the farm. Estimate the cost of shipping a carload of hay to St. Paul and also the cost of shipping a carload of cattle. What are the net returns of each? What are your conclusions?

Cultivation. Two things must be considered in growing grasses. First, are they grown for hay? Second, are they grown for pasture and ornamental purposes? Whether for hay or pasture, it is advisable to grow several kinds of grasses together. Good pasture must contain grasses that ripen at different times to give fresh grass through the entire season. Hay should be made up of those grasses which ripen at about the same time. It is necessary to know the kinds that are adapted to a particular climate. Some kinds will winter kill more easily than others. Grass land must be kept up the same as land upon which wheat and other crops are grown. This can be done by growing clover with the other grasses, top dressing with either manure or commercial fertilizers and by plowing under a fall or late spring growth and reseeding. Grass seeds are very small and require considerable moisture in germination. The seed bed should be compact. Most grasses obtain the best start when sown with a crop. A grass that grows short and thick is used for pasture. Examples of pasture grasses are June grass, Kentucky Blue Grass, and White Clover. Hay should be cut when the plant is in blossom, otherwise the nourishment will go to the maturing seed.

The Forage Crops. Forage crops are divided into two classes. (a) Grasses—Timothy, brome grass, Kentucky Blue Grass, orchard grass, millet, red top, and rye grass. (b) Legumes—Red clover, mammouth clover, white clover, alsike clover, alfalfa, and beans.

Questions. The following questions will bring out the leading facts concerning each of the above as well as give a means of identification. To what height does it grow? What is the color of the stem? Is it hollow? How many nodes on an ordinary stem? Where are the leaves found? Their shape and number? Describe the roots. Is the head awned or awnless? Is it compact, spike, or panicle? How much does a bushel of seed weight? Amount sown per acre? When is it sown, in the fall or spring? When harvested, and how har-

vested? It runs its life history in how many years? Has it any peculiar habits of growth? Explain. Adapted to what kind of soil? How should the soil be prepared? Is it grown for pasture or hay? What kind of a climate is necessary? What are the distinguishing characteristics of the legumes? Are these plants grown successfully in this state? Be able to identify the different seeds.

Flax.

Description. Flax is an annual plant, growing to the height of about two feet. It has several branches coming from the main stems near the ground. The flowers are blue. It is a hardy plant and can grow upon new land that is not well broken. If flax is grown for the fiber it should be sown thick so there will be few branches. If sown for seed not so much should be planted, then there will be many branches.

Uses. The seed contains a large amount of oil. This is used in paints and in making oil cake for stock. Linseed oil is a common article of commerce. The stem is made up of a large number of long cell fibers joined together. These are used to make twine, thread and linen cloth. The straw is fed to stock.

Cultivation. The seed should be sown after all danger of frost is past. Soil should be well pressed about the seed. Sow from two to three pecks per acre, depending upon the condition of the land. It requires a moist, warm climate and a sandy loam soil. The seed contains a large amount of nitrogen, potash, and phosphoric acid, all of which elements are necessary to the soil. It is grown in the United States, Germany, and Russia. It dates back to the early Egyptians. Linen cloth is frequently mentioned in the Bible.

Diseases. If grown two years in succession upon the same ground the soil is liable to become "flax sick". There is no remedy for this disease except not to plant flax on land that contains flax wilt. After five years it is reasonably safe to plant flax upon the land that was once thus afflicted. The time is not far distant when it will be possible to raise a strain of flax that will resist the wilt.

Weeds.

Description. "A weed is a plant out of place". When a plant has no economic value it may be called a weed. A beautiful rose may be a weed if it persists in growing where it is not wanted or where a plant of more use is desired. Weeds are classified as annual, biennial, and perennial. Annual weeds are those that complete their life history in one year. They constitute the largest class of weeds and are difficult to handle because of the great numbers. They should

never be permitted to seed. Biennial weeds are those that start one season and blossom the next. The common bull thistle is an example. They should be cut off early the second season. Perennial weeds are those that live through several years. Examples are quack grass and wild morning glory. Many of them are provided with an underground stem. The more we cultivate these the more weed plants we have. Every time this underground stem is cut it produces double the number of plants. The best remedy is to smother them with a thick covering or to prevent the leaves maturing which will deprive the underground part of nourishment.

Disadvantages. See Shepperd & McDowell's work on Agriculture.

Eradication. Many weed seeds are able to lie in the ground several years and when given the right conditions they will germinate. Therefore the first method of eradication is to prevent them from seeding. Early cultivation and mowing will do this. Plant only seed that is free from weed seed. Weeds should not be permitted to grow along the road side, near the fences, or on uncultivated land. The seeds are often provided with wings which enable them to be carried by the wind from place to place. Lastly, weeds may be eradicated through a chemical spray. This last method is being perfected by Professor Bolley of the Agricultural College.

A Few Common Weeds. Wild Oats. These are larger and earlier than the cultivated oat. They have long twisted awns. The grain is very light and falls to the ground as soon as it is ripe. Seeds will remain in the ground for years before germinating. Warm,moist soil will aid in germination. It is therefore of interest to see that soil which contains wild oat seed is stirred and rendered conducive to their germination. This weed is most troublesome when oats, wheat, and barley are grown. A rotation should be followed which includes several cultivated crops, as corn and potatoes. Frequent harvesting and summer fallowing will also eradicate them.

Canada Thistles. This weed has not infested North Dakota to any extent. The fact that it has an underground stem makes it one of the most difficult weeds to eradicate. It produces numerous seeds provided with downy hairs. The flowers are purple heads. Through cultivation, salt applied to the roots, or heavy cropping will eradicate them. If there are only a few patches of them they may be smothered out with straw or manure.

Wild Mustard. It resembles a radish plant. Yellow flowers are found on the ends of the stems. The lower flowers on the stems open first. The plant should be pulled up just as it commences to blossom. The method of eradicating the wild oats may be pursued with this weed.

Quack Grass. Unlike most other weeds this one has an economic value. It is one of the best grasses for fodder. When once it has taken possession of a piece of land it is almost impossible to eradicate it. The underground stems may become so firmly massed that it is difficult to force the plow through. The underground stems are rich in nourishment, are enjoyed by hogs and even cattle. Continual plowing as soon as the leaves appear, is the best remedy that can be applied. One season of this treatment will do away with most of the quack grass.

Pupils should be able to recognize the common weeds of the state. It is instructive, as well as interesting, to require each pupil in the school to make a weed collection. Mount them on cardboard 12x6 inches with a brief description of the weed.

Horticulture.

What It Includes. Horticulture includes the cultivation of those trees which produce fruit for man and those vegetables ordinarily grown in the garden. Landscape gardening must also be included under the term horticulture.

The Selection of a Site. Several elements must be considered in the planning of an orchard or garden. 1. The soil. Soil that is run out is clearly not suitable for this purpose. It must be dry and yet capable of holding moisture. Low land is wet and liable to frost early. Land that has a gentle slope with a northern exposure is best. 2. Wind breaks. In a state where the climate is as severe as North Dakota it is necessary to provide wind breaks. Buildings, groves, and natural slopes will serve to protect trees or garden vegetables.

Convenience. Fruit trees and gardens should be near the house. Most of the work done on these is done at odd times. Further, it should be near enough to obtain the produce just before it is used.

Cultivation. The land should be plowed deep and thoroughly pulverized. Manure should be added to the land before it is plowed. The rows of trees should be far enough apart to permit free cultivation and plenty of sunshine. Potatoes and grain should not be grown in an orchard. All the nourishment will be needed by the trees in the years to come. Grass may be sown in an orchard that has borne fruit for some time. This, however, should be turned under frequently to add humus to the soil. The home garden should be planned with the idea of producing something for the home from early summer to late fall. The rows should be far enough apart to permit horse cultivation. Small plants should be planted at one side of the garden and the larger ones at another. Weeds have no place in a garden, even late in the fall. They take

the plant food and mar the beauty of what a garden should be. In the fall every weed should be removed and burned before it seeds. This will insure a clean garden the following year. Crop rotation in the garden should be practiced. The worth of a garden to a home cannot be estimated. Further, the value to a child is greater than many mere descriptions. Encourage pupils to make their own gardens.

Pruning. Pruning is the cutting away of a part of a plant to change the shape, to aid in the development of other parts, or to eradicate some disease. It should be done when the plant is young and either in the winter or early spring. The cut surfaces should be covered with paint or grafting wax. Each kind of tree requires its particular method of pruning. Every branch should be cut off close to the trunk or main stem.

Enemies of the Orchard and Garden. These are of two classes, those which obtain their food through sucking and those which obtain their food by means of biting. The first class obtain their food from the juice of the plant while the latter eat the tissues. Likewise, the remedies fall under two heads. For those insects which live upon the juices of the plant emulsions should be used. One of the best is known as the kerosene emulsion. It is prepared by dissolving two pounds of hard soap in one gallon of boiling water, and adding two gallons of oil. After thoroughly mixing, dilute and spray the trees before the buds open. To kill insects which live upon the tissues arsenic poisons should be used. Examples of these are: Paris Green, Bordeaux Mixture, and Arsenite of Lead. Leaf blight, scab, rust, and rot are remedied by using the Bordeaux Mixture, also. This is prepared by dissolving thoroughly four pounds of blue vitriol and four pounds of quick lime in fifty gallons of water. It should be used when fresh.

Transplanting Trees. This brief paragraph is given for the instruction of pupils and teachers who desire to plant trees on the school ground. Up to this time this work of our schools has not been very successful. The following directions, if carefully followed, will render the work more profitable. The ground should be thoroughly prepared before transplanting. It is safe to say that the same preparation is necessary in transplanting trees that is necessary in preparing a garden. The holes should be large enough to hold all the roots in their natural position. No roots should be bent. The tree should be planted somewhat deeper than it was in its previous home. As few roots should be injured as possible. Dip the roots in water or mud before planting. Fine, rich earth should be packed about each root. The time elapsing between the transfer should be as short as possible. Pack the dirt firmly about the tree, leaving a soil mulch of three inches on top. The top should not be much larger than the root-system. Water

frequently in dry weather. Place fertilizers a few feet from the stem. Try to have the new home as nearly like the old one as possible.

Plant Breeding.

Definition. Plant breeding is the improving of plants with the end of obtaining a desired variety. To do this it is necessary to know the entire life history of the plant. It is also necessary to know the laws governing the reproduction of plants. In general an off-spring, whether plant or animal. resembles its parents. The fact that there are slight differences in the offspring is of great importance to the breeder. It is by taking advantage of these differences that new varieties are obtained. This law that like does not always produce exactly its own likeness is called the law of **variation.** The fact that certain characteristics are given by the parents to the offspring is called the law of heridity.

How to Produce the Desired Kind. This can best be shown by selecting, for example, a stalk of corn which in all its characteristics is better than any other stalk in the field. This is only the first step in the work of establishing a better variety. Care must be taken that the seed of this stalk of corn is planted under the most favorable conditions, that it does not cross with another variety or a less desirable plant of the same variety. The best seed of this year's growth is selected and the same care is given it as before. After several years the desired variety becomes well established and the difficult task is accomplished.

Other Methods of Propagation. In the previous paragraph the method of improvement was through the seed. A plant may be propagated through what is known as vegetative propagation. It is more certain of producing the desired kind and does not take the amount of time that the seed method requires.

(a) **Cuttings.** A branch of the desired kind from eight to ten inches long, with a bud near the cut off end is inserted in the ground with the soil pressed firmly about it. When several cuttings are planted it is well to plant them well together. In three years and often less time, they will be ready to transplant to their permanent home. The cutting should contain several buds. Such plants as the gooseberry and currants are easily propagated in this way.

(b) **Budding.** This method is closely related to grafting. A T-shaped cut is made in the bark. A bud should be cut out deep enough to remove some of the under wood. Insert the bud in the T. The points of the T are pressed about the bud and then tied in place with cotton twine. The best time to bud is in August. The bud should be taken from a tree one

year old. The insertion should be made on the north side of the tree to avoid strong sunlight. Budding does the best on trees closely related, as, for example, the apple and quince.

(c) **Grafting.** Grafting is the bringing together of the cambium layers of two plants so that they will unite. The part which is united with the permanent stem is called the scion and the permanent, or part to which the scion is united is called the stock. Grafting should be done early in the spring before the sap rises in the stem. Non-seed producing plants are thus propagated. Air must be excluded from the grafted parts. This is done by covering the wounded parts with grafting wax. Resin, beeswax, and tallow will make a good wax.

The most common methods of grafting are: (a) Whip-grafting.—The ends of the scion is made into tongue and a cleft is cut into the stock. These are united so that the inner bark of the scion must come in contact with the inner bark of the stock. The scion should be about four inches long and should have three healthy buds, one near the end. (b) Cleft-Grafting.—This is used on the large branches or on the top of trees. The branch to be grafted is cut straight across and then split to the depth of three inches. Place a scion at each edge of the split. These should be cut wedge-shaped and inserted so that the cambiums come in contact. Cover the entire cut surface with grafting wax. (c) Other methods are root-grafting, side-grafting, and splice-grafting. If the first methods are thoroughly understood these others are easily done.

Farm Animals.

The topics of the previous pages have had to do with plants. Plants are grown that animals may subsist. Our study of plant life would not be complete if we did not trace them to their final economic purposes and see what relation they bear to animal life.

Classification of Animals.

1. Mammals—Cat, horse, swine, and dog.
2. Birds—Duck, goose, pigeon, and hen.
3. Insects—Fly, bee, and mosquito.

Why Raise Animals. Animals are of use on the farm in the following ways: They furnish food and clothing; they are beasts of burden; they furnish food for the land, utilize farm products, add to human enjoyment, help to prepare the soil for use, and distribute labor throughout the year.

Kinds to Raise. It is safe to say that a person should not raise a kind of animal that he does not like. Animals are improved and made to meet the requirements only, when they are of particular interest to the one who raises them. The

next question to decide is, what kind is best adapted to local conditions. The farmer with a small farm will desire to raise cattle that serve the dual purpose of producing a liberal amount of milk and at the same time of serving fairly well for beef purposes. It is necessary to ask, "What do I wish to do with this animal?" After the question has been decided, select the animal that comes nearest to the qualifications that such an animal should have. Every effort should then be turned to the improvement of this breed. Such an animal will best meet the demand. "Scrub" animals should have no place on the farm.

Care of Animals. The care and attention given to animals determines to a great extent their worth. It is poor economy to feed well and not house well. Animals should be provided with warm shelter, well lighted and ventilated. Cleanliness is as necessary to even the hog, as to the horse or cow. Kindness is appreciated and adds to the worth of the animal by forming a good disposition. Horses, mules, and oxen need at least one day a week of rest. When not at work in the dull season they should be allowed proper exercise. Blankets are appreciated by animals as well as man. Both horses and cows should be groomed once a day.

Food for Animals. Food is necessary to keep the body warm, produce energy and build up destroyed body tissue. Some foods serve these purposes better than others. The same principles that apply to the human being apply to the lower animal. Food should be selected that is ripe, well prepared and fills the purpose for which it is fed. The work horse does not require the kind of food or as much food when idle that he requires in harvest time. Neither does the young heifer require the food that the milch cow requires. Feed at a regular time and not too much or too little. A change of food is desirable. Certain foods can be made more tempting and will aid in the digestive process. The animal should have at all times access to fresh water.

Classification of Foods. Foods are classified as: 1. Protein. 2. Carbohydrates. 3. Fat. 4. Mineral Matter. Protein foods are those which build up every part of the body and assist in producing heat, fat, and energy. Examples are the various grains which are used for foods. Carbohydrates are those which furnish heat, energy, and fat. They are foods which contain starch in large quantities. Fat foods are such as contain considerable oil or fat. Example is cotton-seed meal. The mineral matter is obtained from the soil through water and plant tissue. It is used to form bone and teeth.

Cattle.

History. At one time cattle included all the stock on the farm. They are descended from the wild ox of Europe and

Asia. Our knowledge of cattle dates back a comparatively short time, yet it is known that cattle were raised and domesticated very early in history, if not in prehistoric times.

Classification of Cattle. There are three classes:

(a) Beef—Shorthorn, Aberdeen, Angus, Pooled, Durham, Hereford, and Galloway.

(b) Dairy—Jersey, Guernsey, Holstein, Archire, and Brown Swiss.

(c) Dual Purposes—Devon, Red Polled, and Brown Swiss.

Characteristics of Each. (a) Beef Animals. Such an animal should be well developed in loin, back, thighs, and rump. Smooth outlines, short, stout legs, with a broad back. Fine hair, pliable skin, and small bones. (b) Dairy Animal. The dairy cow has a large stomach, udder is wide and full, milk veins large and branching. When looked at from the front the animal has a wedge shape. The hip bones are prominent, neck small, head small, skin clear, hair fine and soft. Such an animal must produce at least 250 pounds of butter per year. (c) Dual Purpose Animal. These animals are used for beef and dairy purposes. They should have some of the most marked characteristics of the other two. For the small farm these are well adapted:

Topics of Study. Each of the above named beef, dairy, and dual purpose breds should be taken up in the following manner. (a) Origin and History. (b) Appearance. (c) Adaptability to this state. (d) Milking and beef qualities. (e) Other interesting points. Visit a farm, if possible, where cattle may be judged according to the above points. Milking, cleanliness about the barn, pails, churn, quantity and quality of milk from different cows compared, should be considered.

Horses.

History. The horse of today came from an animal much smaller. Climate and plenty of food developed our present horse. Just how far back the horse dates we are not certain. In Genesis we read "An adder that biteth the horse heels," and agin, "With all the horses and chariots". Horse flesh has been used for food. Selection, with a certain type in mind, has given us the many breeds.

Classification of Horses. There are three classes: (a) Draft breeds—Percheron, Clydesdale, Suffolk Punch, Belgian, and English Shire. (b) Carriage or Coach breeds—American Trotter, Hadsney, French Coach, German Coach, and Cleveland Bay. (c) Saddle breeds—The Thoroughbred and American Saddler.

Characteristics of Each. (a) Draft horses are broad, deep chested, with large feet, wide hocks, short necks, and short

legs. They should weigh about 1800 pounds. They are used for heavy work. On the farm they should be lighter than those used in the city for truck purposes. (b) Carriage horses are much smaller than draft horses. They should weigh about 1300 pounds. Beauty of form and ability on the road are their dominant characteristics. (c) Saddle horses have long backs and withers, long legs, with well developed muscles, narrow chests and thin necks. They are bred largely in Kentucky and Missouri. Bays, chestnut, and browns are the leading colors.

Topics of Study. 1. Origin of each of the above mentioned types. 2. Color, weight, and height. 3. Care of feet. 4. Bad habits 5. Disposition. 6. Cost to keep a horse. 7. Prices of horses. 8. How does it compare with a few years ago? Explain. 9. Explain what we mean by giving one horse "an advantage". 10. How do you tell the age of a horse? 11. Best records made on the race track. 12. Has a horse memory?

Poultry Raising.

The economic value of raising poultry on the farm or as an industry has not been rightly estimated. The value of eggs and poultry produced in the United States in one year is more than half a million dollars. Thirty-five hens given proper care the year through, will almost support a small family.

Care of Poultry. The poultry house should be located on a spot where the drainage is good, where there is plenty of sunlight, and where it is protected from the wind. The house should be large enough to give each fowl four square feet of surface. The yard should be at least ten times the size of the house. Not more than thirty fowls should be kept together. If the drainage is good, a hard ground floor is sufficient, otherwise, a hard wood floor should be provided. Straw, leaves, and fine dust should cover it. The building should be warm and provided with windows to admit sunlight. Cleanliness of building and freedom from lice will add to the comfort of the fowls and to the profit to the owner. Sick ones should be removed at once and either killed or placed in a house some distance from the others.

Feeding. The importance of this topic calls for a separate paragraph. Over-feeding has the same effect upon fowls that it does upon human beings. Poultry should be fed twice a day. Feed them food that will supply albumen as well as the other necessary elements. Meat will furnish albumen. Green material is necessary for both winter and summer food. Cut off grass, cabbage, and beets furnish excellent green food. Sand and crushed bone or oyster shells should be placed in a box within reach. Corn and wheat should alternate. Plenty of fresh water, arranged so that it is accessible to the head only.

Breeds of Poultry. 1. Egg breeds—Leghorn, Minorea, Houdan. (a) Leghorns: Small, active, either white, brown, or black, with large red combs. Commence to lay when five months old and are good producers for five years. (b) Minorcas: Larger than the Leghorns and rank second of the egg producing fowls. Weight about seven pounds. (c) Houdans: One of the most beautiful birds. They have a top-knot and a V-shaped comb. Five toes on each foot. They are good layers.

2. Meat breeds—Brahams, Cochins, and Langshans. (a) Brahams: Very large, with feathers on the legs. Color either dark or light. Young mature slowly. Quiet in disposition and easily kept about farm buildings. (b) Cochins: These are of three varieties, buff, black, white and partridge. Weight eight to eleven pounds. Feathers on the legs. They are good sitters. (c) Langshans: Smaller than the other meat breeds, and are good foragers. Color, black and white.

3. General Purpose Breeds—Plymouth Rocks and Wyandottes. (a) Plymouth Rocks are the most popular of fowls. The barred variety leads. There are also the white and buff varieties. They are hardy, adapted to most any climate, fair egg producers, and good mothers.

Swine.

The raising of hogs is confined largely to the corn belt. There is no reason why any part of the United States that produces cloevr, alfalfa, wheat, oats, or rye cannot produce hogs successfully and witha liberal profit. Much might be written as to the care, advantages and many other interesting topics. It is enough to say that what has been said of animals in general applies also to the hog. Cleanliness, food, shelter, exercise, fresh water, and the best breeds are elements that must be considered in successful swine raising.

Breeds. 1. Fat Hogs—Chester White, Berkshire, Poland China, and Cheshire.

2. Bacon Hogs—Tamworth and Yorkshire.

The hogs used for fatting purposes should have small bones, straight backs, small head and heavy hams and shoulders. The hogs raised for bacon purposes should have long sides, belly wide and deep, back narrow, and with only a small amount of fat. The fat and lean meat should be well distributed over the body.

Topics. Ask the Department of Agriculture at Washington to send you Bulletin No. 134 of the Farmers' series. What does it cost to keep a hog? Is pork wholesome? How should it be cooked? Trace the early history of hogs. How much does an ordinary fat hog weigh? What prices does it bring in St. Paul? Uses of the different parts of a hog.

Birds and Insects.

These two topics have such a close relation to the subject of Agriculture that it seems best to study them together. The number of birds from year to year is becoming less and as a result injurious insects are increasing. Birds live upon insects rather than upon farm crops, as is ordinarily supposed. True, they may destroy some grain, but the help they are in destroying insects, that would otherwise eat upon the grain, more than overbalances the evil effects. The English Sparrow is an exception. It not only eats grain but drives away the other birds. Swallows, wrens, chickadees , woodpeckers, cuckoos, blue birds, and many others are great insect eaters and should be encouraged to make their homes among us. Children should never rob their nests or frighten them away from the home buildings. Make friends of them, it will be worth your time.

Not all insects are injurious. Some fertilize flowers, others are used to make fuel for man, act as scavengers, furnish material for clothing and ornamental purposes. Some of the harmful influences are: They destroy farm and garden crops, orchards, trees, injure animals and man, and carry diseases.

To know to just which class a particular insect belongs, is not always easy. It is necessary to study the life history, watch it in its daily work, determine its method of obtaining food, and after a thorough acquaintance is made, determine to which class it belongs, the beneficial or the harmful.

Every pupil in school should know the name of the common insects and their habits of life. It is interesting to make a collection of insects. Run a needle through their bodies and join them to corks. Afterwards they may be transferred to mounting boards.

Problems of Agriculture. The following topics are given as supplementary to the regular outline. They should receive attention from time to time, not as assigned work, but as topics to be discussed between teacher and pupils. How the farmer spends his time during the different months of the year. The leading crops raised in the community. The success of the farmer depends upon his education, liking for the work, energy, economy, past experiences, personal and otherwise, use of improved methods, selling at the right time, and planting what is demanded. What are some of the improvements in farming? Compare farming today with that of twenty years ago. How can farm life be made more attractive? Compare farm life, under the present conditions, with the life of an ordinary boy in the city. Do country boys and girls find life in the city easy? Give a summary of all the advantages of life in the country. Study North Dakota as one great farm, considering its climate, soil, and methods of transportation in different parts of the state.

The School Garden.

The school garden is the place where many of the principles taught in the school can be put into actual practice. The advantage of such a garden is summed up by a noted educator in the following sentence: "Garden work, properly directed and managed with pleasure and understanding, promotes industry, attention, judgment, skill, and self-reliance; it developes the sense of order, cleanliness, punctuality, beauty, responsibility, and duty, and consequently forms the foundation for a firm will and self-reliant action, or in other words, for a moral character."

When possible, each pupil should have a garden of his own. If the the school is large and the school ground small, it may be necessary to have one general garden. In this case, each pupil should have one at home. The teacher should give the directions and frequently visit the pupil's home garden. The work on the one large school garden should be done by the pupils, under the immediate direction of the teacher. Each pupil should beassigned his particular work, from the preparing of the soil to the harvesting of the garden produce.

The work may be summed up as follows: A diagram of the plot should be placed on the blackboard. The teacher should explain the area of the whole, the number of feet to be devoted to each vegetable or flower and the plaec where each is to be planted. Each pupil should be assigned certain seeds to test and a lesson on seed testing to follow. The next step is the preparation of the soil. Each pupil should have a part. A lesson on soil and soil preparation should follow. Consult the notes in the Bulletin on soil. Planting is more difficult and should be carefully directed by the teacher. Each pupil should do his part of the seeding, hoeing, making a soil mulch, thinning, transplanting, and harvesting. Each pupil should keep a record of the cost of the seed, day planted, when the first seed germinated, or came through the ground, facts as to weather, care and harvest. These can be used in composition work later.

Radishes, lettuce, beans, beets, onions, tomatoes, and cabbage, can be grown in a school garden.

Reference Books.

Every school library should contain the following books. Each school should take a weekly agricultural paper. Children should also be encouraged to bring from home any book, paper, or magazine that will assist in this work of the study of agriculture.

AUTHOR	NAME	PUB.	PRICE
Shepperd & McDowell	Elements of Agriculture	Webb Pub. Co.	$ .80
Bailey, L. H.	Principles of Agriculture	MacMillan	1.25
Goodrich	First Book of Farming	Doubleday	1.10
Burkett, Stevens & Hill	Agriculture for Beginners	Ginn & Co.	.90
Goff & Mayne	First Principles of Agriculture	University Press Co., Lincoln, N...	.60
King, F. H.	The Soil	MacMillan Co.	1.25
Jackson & Daugherty	Agriculture Through Laboratory and School Garden	Judd & Co.	1.50
Hunt	Cereals in America	Judd & Co.	1.75
James	Practical Agriculture	Appleton Co.	.80

Bulletins published by the United States Department of Agriculture, Washington, D. C.

Farmers'	Bulletin	No.	28.	Weeds, and How to Kill Them.
"	"	"	35.	Potato Culture.
"	"	"	44.	Commercial Fertilizers.
"	"	"	51.	Standard Varieties of Chickens.
"	"	"	54.	Some Common Birds.
"	"	"	55.	The Dairy Herd.
"	"	"	57.	Butter Making on the Farm.
"	"	"	63.	Care of Milk on the Farm.
"	"	"	66.	Meadows and Pastures.
"	"	"	75.	The Grain Smuts.
"	"	"	95.	Good Roads for the Farmer.
"	"	"	99.	Insect Enemies of Shade Trees.
"	"	"	111.	Farmers' Interest in Good Seed.
"	"	"	126.	Practical Suggestions for Farm Bldgs.
"	"	"	132.	Insect Enemies of Growing Wheat.
"	"	"	134.	Tree Planting in Rural School Grounds.
"	"	"	157.	The Propagation of Plants.
"	"	"	183.	Meat on the Farm.

The United States Department of Agriculture will send to any person upon application, a list of the Bulletins published each month.

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